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Monitoring of surface water resources in East Africa using CryoSat-2 radar altimetry and Sentinel-1 SAR imagery

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The availability of discharge observations is declining globally due to increasing delays, restrictions on data access and reduced monitoring efforts. Remote sensing observations can supplement in-situ observations and support water management efforts by providing high quality baseline observations of water fluxes and storages. For instance, several databases provide global and publically available time series of water surface elevation for inland water bodies from satellite altimetry observations, and datasets of water extent are available based on data from satellite missions such as Landsat. Spaceborne observations of terrestrial water bodies can provide answers to important questions concerning the spatio-temporal variability and distribution of surface water, particularly in remote or ungauged areas. Examples include improving simulations of river dynamics and supporting flood management efforts. In this study, we explore how remote sensing of surface water area and water surface elevation can be used to extract information about surface water resources in East Africa, specifically selected East African Lakes and the Zambezi river basin.

We use Sentinel-1 Synthetic Aperture Radar (SAR) imagery to create water masks at a high spatial and temporal resolution for selected East African Lakes and the Zambezi river basin. Sentinel-1 has a 12-day repeat cycle with the current two-satellite constellation. Unlike optical and thermal imagery, microwaves are cloud penetrating – a significant advantage in many regions. These two features enable us to monitor the dynamics of surface water. We extract CryoSat-2 satellite altimetry observations using the Sentinel-1 water mask. CryoSat-2 has a 369-day repeat cycle resulting in dense ground tracks. This means smaller water bodies can be monitored and large water bodies are observed at high overpass frequency. Although it is not possible to extract time series at specific locations along a river line, we obtain a longitudinal profile of the water surface elevation in the river. We compare the estimated water surface elevations with in-situ data where possible.

We show that CryoSat-2 observations can provide useful information on water levels for inland water bodies in Eastern Africa, and demonstrate the potential for using Sentinel-1 SAR water surface area observations synergistically with radar altimetry missions over rivers and lakes for monitoring water surface extent and river dynamics.